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Solid Waste Data: A Compilation of Statistics on Solid Waste Management within the United States

JRB Associates, Inc.
McLean, VA

Prepared for

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1981

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A Compilation of Statistics on Solid Waste Management Within the United States

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U.S. ENVIRONMENTAL PROTECTION AGENCY
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FOREWORD

This report has been prepared for the Office of Solid Waste and Emergency Response under the EPA Headquarters Technical Assistance Panels Program and represents a comprehensive compilation of the most current available information on solid waste management within the United States. This information is presented in tabular form and organized by general categories for ease of reference.

Where current information was unavailable, the most recent data were updated to 1980 by JRB Associates where appropriate. In instances where conflicting data were found, the data collection and analysis methodologies of each source were evaluated and those data found to be most appropriate for a national overview were selected.

The general categories, by which this report is organized, are the following:

I. Generation
II. Employment
III. Composition
IV. Collection
V. Transportation
VI. Processing
VII. Disposal
VIII. Rural Waste
IX. Resource Recovery
X. Municipal Sludge
XI. Hazardous Waste
XII. Miscellaneous Information

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CONTENTS

		Page
I.	GENERATION	
	I-1 Estimated Quantities of Solid Waste Generated	1
	I-2 Trends in Residential and Commercial Waste Generation	1
II.	EMPLOYMENT	
	II-1 Employment in Municipal Solid Waste Management	3
	II-2 Municipal Expenditures for Salaries and Wages in Refuse Departments	4
	II-3 Average Hourly Wages of Private Refuse Haulers	4
III.	COMPOSITION	
	III-1 Net Quantity and Composition of Post-Consumer Residential and Commercial Solid Waste by Type of Material	5
	III-2 Net Quantity and Composition of Post-Consumer Residential and Commercial Solid Waste By Detailed Product Category	6
IV.	COLLECTION	
	IV-1 Collection Service Arrangement	7
	IV-2 Refuse Collection Location by Community Size	7
	IV-3 Refuse Collection Location By Selected Geographical Regions	8
	IV-4 Frequency of Refuse Collection By Selected Geographical Regions	8
	IV-5 Frequency of Refuse Collection By Community Size	9
	IV-6 Effect of Crew Size and Level of Service on Collection Efficiency	9
	IV-7 Refuse Trucks and Crew Size By Population Served	10
	IV-8 Type and Quantities of Solid Waste Collection Vehicles Used By Municipalities and Private Firms	10
	IV-9 Ratio Rear Loaders to Side Loaders	11
	IV-10 Types of Refuse Collection Vehicles Used By Private Firms.	11
	IV-11 Type of Fuel Used By Residential and Commercial Collection Vehicles.	12
	IV-12 Private Refuse Collectors: Percentage Diesel Fueled Vehicles	12
	IV-13 Effect of Crew Size and Service Level on Collection Costs.	13
	IV-14 Average Dollar Per Ton Cost of Refuse Collection By Service Arrangement and Community Size	14
	IV-15 Average Collection Cost By Community Size.	14
	IV-16 Cost Components For Municipal Collection of Residential Refuse	15
	IV-17 Collection Cost Components for Private Collection Firms.	15
	IV-18 Payment Mode for Refuse Collection From Single Family Dwellings By Community Size	16
	IV-19 Payment Mode for Refuse Collection By Service Recipient.	17
	IV-20 Payment Mode for Refuse Collection By Service Arrangement.	17

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CONTENTS (Continued)

		Page
V.	TRANSPORTATION	
	V-1 Comparison of Direct and Transfer Haul Costs.	19
VI.	PROCESSING	
	VI-1 Summary of Incinerator Use	21
	VI-2 1980 Baling Facilities By Operating Capacity	21
	VI-3 Vital Statistics of Baler Facilities	22
	VI-4 1980 Shredder Facilities By Operating Capacity	24
	VI-5 Vital Statistics - Shredder Facilities	25
	VI-6 Shredder Facility Costs.	30
	VI-7 Transfer System Costs.	30
	VI-8 Transfer Station Usage	31
VII.	DISPOSAL	
	VII-1 Municipal Solid Waste Disposal By Method.	33
	VII-2 Average Disposal Costs By City Size	33
	VII-3 Estimated Costs for Municipal Solid Waste Incineration. .	34
	VII-4 Breakdown of Sanitary Landfill Capacity	34
VIII.	RURAL WASTE	
	VIII-1 Community Size and Percent of Structures Serviced. . . .	35
	VIII-2 Collection Equipment and Community Size.	35
	VIII-3 Environmental Management Controls for Rural Sanitary Landfills.	36
	VIII-4 Use of Landfill Soil Cover By Rural Community Size. . .	36
	VIII-5 Initial Capital Investment for "Green Box" Container System for Community of 15,000	37
IX.	RESOURCE RECOVERY	
	IX-1 Resource Recovery Facilities By Technology	39
	IX-2 Operating Resource Recovery Facilities By Capacity	39
	IX-3 Comparison of Resource Recovery Technologies	40
	IX-4 Energy Productivity Comparison of Resource Recovery Systems.	41
	IX-5 Resource Recovery Facilities	42
	IX-6 Recyclable Materials as Percent of Total Residential Waste.	45
	IX-7 Energy Savings Through Recycling of Waste Materials. . . .	46
	IX-8 Twenty-Six Operating Waste Exchanges in U.S.	47
	IX-9 Number of Programs Collecting Specific Recyclables	48
	IX-10 Source Separation Collection Responsibilities.	48
	IX-11 Waste Paper Utilization.	49
	IX-12 Total Quantities of Recycled Materials	49
	IX-13 List of Source Separation Programs	50
	IX-14 History of Market Prices for Secondary Materials	55
X.	MUNICIPAL SLUDGE	
	X-1 Chemical Composition of Sewage Sludge, All Types.	57
	X-2 Municipal Sludge Generation	58

CONTENTS (Continued)

		Page
	X-3 Thermal Content of Sewage Sludge.	58
	X-4 Breakdown of Disposal Methods for Municipal Sludge.	59
	X-5 Cost of Municipal Sludge Disposal	60
XI.	HAZARDOUS WASTE	
	XI-1 Estimated Hazardous Waste Generation By Industry	61
	XI-2 Industrial Hazardous Waste Generation By Region.	62
	XI-3 Estimated Hazardous Waste Generation By Waste Type	62
	XI-4 Hazardous Waste Composition By SIC Code.	63
	XI-5 Hazardous Waste Transporters By Region	63
	XI-6 Estimated On-Site and Off-Site Disposal of Hazardous Waste	64
	XI-7 Methods for Off-Site Disposal of Industrial Hazardous Waste	64
	XI-8 Estimated Off-Site Hazardous Waste Treatment/Disposal By Region	65
	XI-9 Regional Breakdown of Hazardous Waste Treatment/Disposal Facilities	65
	XI-10 Cost of Off-Site Hazardous Waste Disposal.	66
XII.	MISCELLANEOUS INFORMATION	
	XII-1 Comparison of Energy Values of Municipal Solid Waste and Conventional Fuels.	67
	XII-2 Common Energy Equivalents	67
	XII-3 Densities of Refuse and Associated Materials.	68
	XII-4 Densities of Pure Refuse Components	68
	XII-5 Typical Chemical Composition of Municipal Refuse Components.	69
	REFERENCES	71

I. Generation

I-1 ESTIMATED QUANTITIES OF SOLID WASTE GENERATED IN 1977

Waste Source	Metric Tons (millions)	Short Tons (millions)	% of Total
Municipal			
Residential/Commercial/Institutional	132	145	2.4
Sewage Sludge[1]	4.5	5.0	.1
Junked Auto and Construction/Demolition[1]	41	45	.6
Industrial			
Non-hazardous	292-310	323-342	5.5
Hazardous	34-52	38-57	.8
Radioactive[1]	.04	.04	<.1
Mining/Milling[1] (Includes uranium tailings)	2086	2300	39.0
Agricultural[2]	2265-3014	2498-3323	50.3
Utility[3]	70	77	1.2

[1] In dry weight (all other source tonnages are in wet weights).
[2] Includes residues from crop growing, harvesting, and processing; meat, poultry, and dairy products; and logging and wood manufacture.
[3] Includes fly and bottom ash and scrubber sludge, excludes radioactive waste.

Source: 16

I-2 TRENDS IN RESIDENTIAL AND COMMERCIAL WASTE GENERATION

	1960	1965	1970	1972	1974	1976	1978
Gross Discards							
Million tons/year	95.7	110.7	131.0	138.5	143.1	143.2	150.4
Lbs/person/day	2.9	3.12	3.5	3.63	3.7	3.65	3.77
% change per capita previous reporting year	-	+7.6	+12.2	+3.7	+2.0	-1.4	+3.2
Resource Recovery							
Million tons/year	6.1	6.4	7.7	8.4	10.5	10.7	12.4
Lbs/person/day	.19	.18	.20	.22	.27	.28	.31
% change per capita previous reporting year	-	-5.3	+11.0	+10.0	+22.7	+3.7	+10.7
Net Disposal							
Million tons/year	89.6	104.3	123.3	130.1	132.6	123.5	138.0
Lbs/person/day	2.72	2.94	3.30	3.41	3.43	3.37	3.46
% change per capita previous reporting year	-	+8.1	+12.2	+3.3	+.58	-1.8	+2.3
Population (millions)	180.7	194.3	204.9	208.9	211.9	215.2	218.7

Source: 11

II. Employment

II-1 EMPLOYMENT IN MUNICIPAL SOLID WASTE MANAGEMENT, 1976

Classification	# of Cities Reporting	Mean # of Employees	# of Employees per 1,000 population
Total, all cities	837	80	1.13
Population			
1,000,000 and over	4	6,251	1.73
500,000-999,999	14	577	0.88
250,000-499,999	19	276	0.79
100,000-249,999	54	134	0.93
50,000- 99,999	113	60	0.87
25,000- 49,999	201	35	1.00
10,000- 24,999	432	18	1.16
Geographic Region			
Northeast	152	144	1.43
North Central	230	61	0.87
South	344	75	1.28
West	111	50	0.69

Data from survey of 2,309 municipalities.

Source: 22

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II-2 MUNICIPAL EXPENDITURE FOR SALARIES AND WAGES IN REFUSE DEPARTMENTS

Year	Per Capita
1976	$ 9.45[1]
1980	13.35[2]

[1] 1976 data from survey of 815 reporting cities with populations $\geq$ 10,000.

[2] 1980 value computed by JRB Associates using the Municipal Cost Index (MCI) published by The American City & County Magazine.

Source: 22

II-3 AVERAGE HOURLY WAGES OF PRIVATE REFUSE HAULERS, 1980

Category	Hourly Rate
General Maintenance	$7.22
Vehicle - Driver	6.71
Vehicle - Helper	5.30

Data from survey of 198 randomly selected private refuse haulers.

Source: 29

III. Composition

III-1 NET QUANTITY AND COMPOSITION OF POST-CONSUMER RESIDENTIAL AND COMMERCIAL SOLID WASTE BY TYPE OF MATERIAL, 1978

Material category	Net Waste Disposed Of	
	Quantity (Millions of Tons)	% of Total Waste
Paper	41.3	29.7
Glass	14.8	10.7
Metals	13.3	9.6
Ferrous	11.6	8.4
Aluminum	1.3	0.9
Other nonferrous	0.4	0.3
Plastics	5.8	4.2
Rubber	2.9	2.1
Leather	0.5	0.4
Textiles	3.4	2.4
Wood	4.8	3.4
Total nonfood product waste	86.8	62.5
Food waste	23.4	16.8
Yard waste	26.6	19.2
Misc. inorganic wastes	2.1	1.5
TOTAL	138.9	100.0

Source: 11

III-2 NET QUANTITY AND COMPOSITION OF POST-CONSUMER RESIDENTIAL AND COMMERCIAL SOLID WASTE BY DETAILED PRODUCT CATEGORY, 1978

Product Category	Net Waste Disposed Of: Quantity (Thousands of Tons)	Net Waste Disposed Of: % of Total Waste
Durable goods:	16,525	12
Major appliances	2,330	2
Furniture, furnishings	5,410	4
Rubber tires	1,650	1
Miscellaneous durables	7,135	5
Nondurable goods, exc. food:	28,110	20
Newspapers	7,670	5
Books, magazines	6,400	5
Office paper	4,305	3
Tissue paper, incl. towels	2,190	2
Paper plates, cups	370	<.5
Other nonpackaging paper	2,475	2
Clothing, footwear	2,765	2
Other misc. nondurables	1,935	1
Containers and packaging:	42,125	30
Glass containers:	13,680	10
Beer, soft drink	6,690	5
Wine, liquor	2,365	2
Food and other	4,625	3
Steel cans:	4,235	3
Beer, soft drink	995	1
Food	2,165	1
Other nonfood	1,075	1
Aluminum:	935	1
Beer, soft drink	610	<.5
Other cans	35	<.5
Aluminum foil	290	<.5
Paper, paperboard:	17,890	13
Corrugated	10,315	7
Other paperboard	3,915	3
Paper packaging	3,660	3
Plastics:	3,640	2
Plastic containers	1,735	1
Other plastic packaging	1,905	1
Wood packaging	1,570	1
Other misc. packaging	175	
Total nonfood product waste	86,760	62
Add: Food waste	23,400	17
Yard waste	26,600	19
Misc. inorganic wastes	2,100	2
TOTAL	138,860	100

Source: 11

IV. Collection

IV-1 COLLECTION SERVICE ARRANGEMENT, 1980

Recipient and Arrangement	Percent
Residential	
Municipal	47.7
Private	45.6
Combination	6.7
Commercial	
Municipal	28.0
Private	55.7
Combination	16.3

Data from survey of 3,470 communities.

Source: 24

IV-2 REFUSE COLLECTION LOCATION BY COMMUNITY SIZE, 1975

Community Size	Collection Location (%)			
	Backyard or Frontyard	Curbside or Alley	Various Locations	Don't Know
>500,000	—	28.6	71.4	--
250,000-499,999	20.8	26.0	45.8	8.3
100,000-249,999	18.6	39.5	39.5	2.3
50,000- 99,999	17.3	42.0	39.3	1.3
25,000- 49,999	8.2	55.9	34.7	1.2
10,000- 24,999	12.8	51.7	33.0	2.5
5,000- 9,999	12.7	55.2	30.7	1.4
2,500- 4,999	9.5	53.4	31.6	1.4

Data from Universal Telephone Survey (UTS) of 1,377 jurisdictions.

Source: 26

IV-3 REFUSE COLLECTION LOCATION BY SELECTED GEOGRAPHICAL REGIONS, 1975

Geographic Region[1]	Collection Location (%)			
	Backyard or Frontyard	Curbside or Alley	Various Locations	Don't Know
Northeast	9.9	64.2	24.0	1.9
North Central	9.3	51.9	37.4	1.4
South	21.8	40.4	35.2	2.5
West	7.5	45.5	46.2	0.7

IV-4 FREQUENCY OF REFUSE COLLECTION BY SELECTED GEOGRAPHICAL REGIONS, 1975

Geographic Region[1]	Collection Frequency (%)				
	More than Twice a Week	Twice a Week	Once a Week	Less than Once a Week	Various Frequencies
Northeast	1.9	22.9	63.8	1.3	10.0
North Central	0.3	11.8	75.6	1.2	11.0
South	3.4	74.5	16.1	--	5.9
West	0.3	23.3	64.7	--	11.6

Data from Universal Telephone Survey (UTS) of 1,377 jurisdictions.

[1]States within each geographic region:

Northeast: CT, ME, MA, NH, RI, VT, NJ, NY, PA

North Central: IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD

South: DL, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX

West: AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, WA

Source: 26

IV-5 FREQUENCY OF REFUSE COLLECTION BY COMMUNITY SIZE, 1975

Community Size	Collection Frequency (%)				
	More than Twice a Week	Twice a Week	Once a Week	Less than Once a Week	Various Frequencies
>500,000	7.1	35.7	57.1	--	--
250,000-499,999	--	62.5	25.0	--	12.5
100,000-249,999	4.7	43.0	44.2	--	8.1
50,000- 99,999	0.7	38.3	50.3	--	10.7
25,000- 49,999	1.2	25.6	65.7	1.2	6.4
10,000- 24,999	1.1	36.7	52.4	--	9.8
5,000- 9,999	2.1	30.0	57.9	1.0	9.0
2,500- 4,999	1.3	24.6	61.9	1.4	11.0

Data from Universal Telephone Survey (UTS) of 1,377 jurisdictions.

Source: 26

IV-6 EFFECT OF CREW SIZE AND LEVEL OF SERVICE ON COLLECTION EFFICIENCY, 1975

Service Level	Crew Size	Direct Labor Hours/Household/Year	Households Per Crew Shift
Curbside, Once/Week	1 man	2.04	274
	2 man	2.73	453
	3 or more	5.05	518
Curbside, Twice/Week	1 man	2.28	318
	2 man	3.93	259
	3 or more	4.99	447
Backyard, Once/Week	1 man	1.63	135
	2 man	3.85	254
	3 or more	6.29	427

Data from survey of 315 cities.

Source: 32

IV-7 REFUSE TRUCKS AND CREW SIZE BY POPULATION SERVED, 1980

Population Served	Truck Type and Crew Size (%)						
	Rear Loader			Side Loader			
	2 man	3 man	4 or more	1 man	2 man	3 man	4 or more
>500,000	41	59	--	100	--	--	--
250,000-500,000	12	43	45	23	57	20	--
100,000-250,000	22	64	14	60	34	6	--
50,000-100,000	30	70	--	48	10	31	11
<50,000	30	47	23	13	87	--	--
Totals	30	58	12	63	24	11	2

Source: 3

IV-8 TYPE AND QUANTITIES OF SOLID WASTE COLLECTION VEHICLES USED BY MUNICIPALITIES AND PRIVATE FIRMS, 1972-1973

Service Arrangement	Type of Vehicle										
	Packers										
	Front Loaders		Side and Rear Loaders		Roll off Tractor		Open (Stake) Trucks		Other[1]		Totals
	#	%	#	%	#	%	#	%	#	%	
Public	1,000	1.0	34,000	33	0	0	4,000	3.9	2,500	2.4	41,500
Private	7,670	7.4	33,932	33	6,496	6.3	7,327	7.1	6,240	6.0	61,665
Totals	8,670	8.4	67,932	66	6,496	6.3	11,327	11	8,740	8.4	103,165

[1] Includes hoist type containers, trains and satellite vehicles.

Source: 28

IV-9 RATIO REAR LOADERS TO SIDE LOADERS, 1980

	# Cities Reporting	# Vehicles	Rear Loaders	Side Loaders
In Use	86	3,399	87%	13%
New Purchases	86	--	65%	30%

Source: 3

IV-10 TYPES OF REFUSE COLLECTION VEHICLES USED BY PRIVATE FIRMS, 1980

Vehicle Type	Percent of Fleet
Rear Loader	38.5
Front Loader	13.4
Side Loader	9.2
Roll Off/Tilt Frame	18.2
Stake, Flat Bed, Dump Truck	8.9
Satellite Vehicle	4.9
Transfer Vehicle	4.5
Container Hoist/Luggar Type	2.4

Data from survey of 198 randomly selected private refuse haulers.

Source: 29

IV-11 TYPE OF FUEL USED BY RESIDENTIAL AND COMMERCIAL COLLECTION VEHICLES, 1972-1973

Service Recipient	Percentage of Collection Vehicles[1]	
	Gasoline	Diesel
Residential	66.1	33.9
Commercial[2]	42.5	57.5
Overall	59.0	41.0

[1]Compiled by JRB Associates.

[2]Includes large apartment complexes serviced by bulk bins.

Source: 28

IV-12 PRIVATE REFUSE COLLECTORS: PERCENTAGE DIESEL FUELED VEHICLES, 1980

Vehicle Type	Percentage Diesel
Rear Loader	50.2
Front Loader	70.4
Side Loader	29.4
Roll Off/Tilt Frame	59.0
Stake, Flatbed, Dump Truck	16.1
Satellite Vehicle	12.9
Transfer Vehicle	18.5
Container Hoist/Luggar Type	48.8
Overall Fleet	49.7
Of New Purchases in 1980	76.0

Data from survey of 198 randomly selected private refuse haulers.

Source: 29

IV-13 EFFECT OF CREW SIZE AND SERVICE LEVEL ON COLLECTION COSTS

Crew Size	Dollars Per Ton[1]					
	Once/Week Curbside		Twice/Week Curbside		Once/Week Backyard	
	1975	1980	1975	1980	1975	1980
1 man	$11.79	$17.85	$14.69	$22.24	$28.97	$43.86
2 man	26.53	40.16	31.63	47.89	24.48	37.06
3 or more	19.46	29.46	25.03	37.90	39.40	59.65

Crew Size	Dollars Per Household[1]					
	Once/Week Curbside		Twice/Week Curbside		Once/Week Backyard	
	1975	1980	1975	1980	1975	1980
1 man	$29.38	$44.48	$44.06	$66.71	$26.53	$40.17
2 man	31.40	47.54	35.80	54.20	37.61	56.94
3 or more	28.33	42.89	33.77	51.13	46.78	70.83

Data from survey of 315 cities.

[1] 1975 costs escalated to 1980 by JRB Associates using the Municipal Cost Index (MCI) published by The American City and County Magazine.

Source: 32

IV-14 AVERAGE DOLLAR PER TON COST OF REFUSE COLLECTION BY SERVICE ARRANGEMENT AND COMMUNITY SIZE

Service Arrangement	Dollars/Ton by Population Group[1]					
	<10,000		10,000-50,000		>50,000	
	1975	1980	1975	1980	1975	1980
Municipal	$22.48	$34.04	$19.47	$29.48	$25.87	$39.17
Contract	18.86	28.55	21.77	32.96	18.09	27.39
Private	28.39	42.98	23.08	34.94	30.81	46.65
All	23.79	36.02	21.08	31.92	25.22	38.18

Data from survey of 315 cities.

[1]1975 costs escalated to 1980 by JRB Associates using the Municipal Cost Index (MCI) published by The American City and County Magazine.

Source: 31

IV-15 AVERAGE COLLECTION COST BY COMMUNITY SIZE

Population	Dollars per Ton[1]	
	1975	1980
Total	$24.93	$37.74
500,000+	34.02	51.51
250,000-499,999	28.19	42.68
100,000-249,999	33.96	51.42
50,000- 99,999	22.99	34.81
25,000- 49,999	25.26	38.24
10,000- 24,999	22.33	33.81
2,500- 9,999	23.41	35.44

Data from NSF survey, sample size of 177.

[1]1975 costs escalated to 1980 by JRB Associates using the Municipal Cost Index (MCI) published by The American City and County Magazine.

Source: 42

IV-16 COST COMPONENTS FOR MUNICIPAL COLLECTION OF RESIDENTIAL REFUSE

Cost Component	Cost Per Household and Percent of Total Cost			
	1975	%	1980	%
Labor[1]	$18.37	57.1	$26.75	54.5
Fringe Benefits[1]	3.88	12.1	5.66	11.5
Operating Costs[2]	1.47	4.4	2.19	4.5
Vehicle Operating Costs				
Fuel[2]	1.10	3.4	3.01	6.1
Other[3]	2.57	8.0	3.95	8.1
Overhead Costs[2]	2.78	8.6	4.27	8.7
Depreciation[4]	2.01	6.3	3.26	6.6
TOTAL	$32.08	99.9	$49.09	100.0

Data from survey of 315 cities, escalated to 1980 by JRB Associates.

[1]Escalated to 1980 using data on wage increases for Sanitation Services from the Office of Employment and Earnings, Department of Labor.
[2]Escalated to 1980 using the Consumer Price Index for Urban Wage Earners (CPI-U).
[3]Escalated to 1980 using Producer Price Indexes (PPIs) for Diesel and Gasoline.
[4]Escalated to 1980 using PPI for Trucks (greater than 10,001 lbs. gvw.)

Source: 32

IV-17 COLLECTION COST COMPONENTS FOR PRIVATE COLLECTION FIRMS

Component	Average % of Total Costs	Percent Increase	
		1980 vs 1979	Expected 1981
Fuel	14.0	29.1	23.9
Disposal Fee	11.3	22.1	18.5
Maintenance/Parts	10.6	19.1	16.0
Equipment:	19.2		
Refuse Trucks		15.6	14.9
Containers		10.0	9.5
Compactors		3.8	5.1
Labor	23.6	14.5	16.3
Insurance	7.1	14.1	11.7
Administration	6.5	8.8	10.4
License Fees	4.3	8.5	7.9
Legal Fees	3.4	7.0	6.9
Overall[1]	100.0	18.7	17.4

[1]Takes into account the percentages of a budget each item represents.

Source: 29

IV-18 PAYMENT MODE FOR REFUSE COLLECTION FROM SINGLE FAMILY DWELLINGS BY COMMUNITY SIZE, 1975

Population Group	Tax	Payment Mode (%)			
		Municipal Flat Fee	Private Flat Fee	Municipal Variable Fee	Private Variable Fee
Total	36.1	19.8	31.3	2.6	10.2
>500,000	71.4	7.1	21.4	--	--
250,000-499,999	45.8	25.0	4.2	12.5	12.5
100,000-249,999	58.0	21.6	9.1	3.4	8.0
50,000- 99,999	46.0	22.7	17.3	4.7	9.3
25,000- 49,999	37.9	20.7	27.2	3.6	10.7
10,000- 24,999	42.0	22.4	22.6	2.3	10.7
5,000- 9,999	34.2	20.0	34.0	2.2	9.7
2,500- 4,999	27.4	17.1	42.8	1.9	10.7

Data from Universal Telephone Survey (UTS) of 1,377 jurisdictions.

Source: 27

IV-19 PAYMENT MODE FOR REFUSE COLLECTION BY SERVICE RECIPIENT, 1975

Service Recipient	Payment Mode (%)			
	Tax	Flat Fee	Variable	Don't Know
Small Residences	42.4	43.8	13.4	.4
Multiple Dwellings	34.0	31.0	33.7	1.3
Commercial Establishments	31.8	16.3	51.8	.1

Data from Universal Telephone Survey (UTS) of 1,377 jurisdictions.

Source: 27

IV-20 PAYMENT MODE FOR REFUSE COLLECTION BY SERVICE ARRANGEMENT, 1975

Service Arrangement	Payment Mode (%)		
	Tax	Flat Fee	Variable Fee
Municipal	58.2	38.1	3.7
Contract	67.4	26.7	5.8
Franchise	NA	66.2	33.8
Private	NA	77.4	22.6

Data from Universal Telephone Survey (UTS) of 1,377 jurisdictions.

Source: 27

V. Transportation

V-1 COMPARISON OF DIRECT AND TRANSFER HAUL COSTS, 1979

Methodology	Roundtrip Time and Dollars/Ton-Minute					
	0	10	20	30	40	50
Direct Haul	-	4.40	8.80	13.20	17.60	22.00
Transfer Haul	9.36	10.26	11.16	12.06	12.96	13.86

Data from transfer station feasibility analysis done in 1979 for a northern California community which employed two-man collection crews. Direct haul costs rose at $.44 per ton-minute, and transfer haul costs started at $9.36 and rose $.09 per ton-minute.

Source: 9

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VI. Processing

VI-1 SUMMARY OF INCINERATOR USE, 1979

TPD Capacity	Number of Incinerators	Percent of Total
0- 250	19	28.4
251- 500	18	26.8
501-1000	25	37.3
1001+	5	7.5
TOTAL	67	100.0

Data includes 3 facilities under construction or in shakedown and does not include resource recovery facilities.

Source: 2

VI-2 1980 BALING FACILITIES BY OPERATING CAPACITY

Operating Rate (TPD)	Number of Facilities[1]	Percent of Total
0-100	9	33
101-250	10	37
251-500	8	30
501+	0	0
TOTAL	27	100

[1] Data compiled by JRB Associates from a listing of baling facilities published in the source. Operating rates for facilities that did not report actual TPD rates were estimated by JRB Associates based on TPH capacities and 8 hour daily operating time.

Source: 47

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VI-3 VITAL STATISTICS OF BALER FACILITIES, 1980

Location	Start-Up Date	Baling Equipment	Rated Capacity (TPH)	Operating Rate (TPD)	Processed Waste Disposition	Status	Owner
Alabama							
Scottsboro	1977	One auto-tie baler	15	60	Balefill; recovers paper and metals	OP	MU
Tuscaloosa	1978	One auto-tie baler	25	230	Balefill; recovers paper and metals	OP	MU
Alaska							
Adak	-	One auto-tie baler	20	-	Balefill; recovers aluminum	OP	Navy
Fairbanks	1979	One high-density, three-stroke baler	50	250	Balefill	OP	MU
Georgia							
Atlanta	1978	Two auto-tie balers	75	250	Balefill	OP	MU
Cobb County	1974	One high-density, three-stroke baler	50	400	Balefill; recovers paper and metals when market dictates	OP	MU
Iowa							
Ames	1976	One auto-tie baler	15	-	Primarily used to bale cardboard	OP	MU
Bettendorf	Projected 1980	One auto-tie baler	25	200 (est)	Balefill; will recover paper and metals	UC	PR
Idaho							
Coeur d'Alene	1979	One auto-tie baler	25	100	Balefill	OP	PR
Maine							
Portland	1978	One high-density, three-stroke baler	50	330	Balefill	OP	MU
Massachusetts							
Westboro	1978	One auto-tie baler	25	175	Balefill; recovers paper	OP	PR
Roxbury	Projected 1980	One auto-tie baler	25	150 (est)	Balefill; will recover paper and metals	UC	PR
Nebraska							
Chadron	1974	One auto-tie baler	15	15	Balefill; recovers paper and metals	OP	MU
Omaha	1975	One high-density, three-stroke baler; two single stroke	50 30 30	300 100 100	Balefill; recovers metals when market dictates	OP	MU

VI-3 (CONTINUED)

New Jersey							
Meadowlands	1980	One high-density, three-stroke baler	50	300	Balefill	OP	HMD
New York							
Monroe County	1979	One auto-tie baler	25	-	Landfill	-	CO
North Hempstead	Projected 1980	Two auto-tie balers	40	-	Balefill	UC	MU
Oyster Bay	1976	One high-density, three-stroke baler	50	400	Balefill	OP	MU
Smithtown	1977	One high-density, three-stroke baler	50	300	Balefill; recovers paper and metals	OP	MU
Springfield	1977	One auto-tie baler	25	-	Balefill	OP	PR
Ohio							
Lake County	1975	One high-density, three-stroke baler	50	325	Balefill; recovers metals when market dictates	OP	MU
South Dakota							
Huron	1979	One auto-tie baler	15	70	Balefill; recovers paper and metals	OP	MU
Washington							
Kittitas	1980	One single-stroke baler	25	30 (est)	Balefill; will recover paper	OP	MU
Pasco	1976	One single-stroke baler	13	50	Balefill; recovers paper	OP	PR
Whitman County	1975	One single-stroke baler	20	60	Balefill	OP	CO
Wyoming							
Torrington	1974	One single-stroke baler	15	10	Balefill	OP	MU
Gillette	Projected 1981	-	-	100 (est)	Balefill; recovers aluminum, cardboard, white goods, rubber	UC	MU

Abbreviations: OP = Operational; UC = Under Construction; MU = Municipal; PR = Private; HMD = Hackensack Meadowlands Development; CO = County

Source: 47

VI-4 1980 SHREDDER FACILITIES BY OPERATING CAPACITY

Operating Rate (TPD)	Number of Facilities[1]	Percent of Total
0-100	2	3
101-250	25	36
251-500	21	30
501-1000	15	22
1001+	6	9
TOTAL	69	100

[1]Data compiled by JRB Associates from a listing of shredder facilities published in the source. Operating rates for facilities that did not report actual TPD rates were estimated by JRB Associates based on TPH capacity and 8 hour daily operating time.

Source: 47

VI-5 VITAL STATISTICS - SHREDDER FACILITIES, 1980

Location	Start-Up Date	Shredding Equipment	Rated Capacity (TPH)	Operating Rate (TPD)	Processed Waste Disposition	Status	Owner
Alaska							
Sitka	1976	One vertical shaft shredder	15	-	Landfill	OP	MU
Anchorage	1979	Two vertical shaft shredder	75 each	800-1,000	Landfill; ferrous recovery possible	OP	MU
Prudhoe Bay	1979	One vertical shaft shredder	15	-	Incineration; recovers energy as steam	OP	MU
California							
Los Angeles	1979	One vertical shaft shredder	15	Varies	Landfill; being converted to fuel production	OP	MU
Mountain View	1972	One vertical shredder	30	-	Landfill; aluminum recovery	NOP	PR
Palomar	1978	Two vertical shaft shredders	50 each	800	Landfill; ferrous recovery	OP	CO, PROP
San Diego	-	One horizontal shredder	35	-	-	NOP	CO
Colorado							
Pueblo	1975	Two vertical shaft shredders	25 each	250-300	Landfill; ferrous recovery	OP	PR
Connecticut							
Ansonia	1974	One horizontal shredder	10	-	Shreds bulky wastes prior to incineration; ferrous recovery	OP	MU
Bridgeport	1978	One horizontal shredder; one flail mill	75	1,800	RDF	OP	PR
Delaware							
New Castle County	1972	Four horizontal shredders	50 each	700	Landfill; ferrous recovery but no markets	OP	PR
Pigeon Point	Under Construction	Two vertical shaft shredders	85	1,000	Recovery ferrous, nonferrous, glass, and air classified fuel from certain solid waste feed stock to produce humus to use as fertilizer and soil conditioner	UC	SO, PROP

VI-5 (CONTINUED)

Florida							
Brevard County	1976	Two horizontal shredders	50 each	1,200	Landfill; ferrous recovery temporarily suspended while detinner relocates	OP	CO
Pompano Beach	1972	-	15			OP	PR
	1978	-	80-100	750-800	Used as landfill cover	OP	PR
South Dade County	Projected 1981	Three horizontal shredders	55 each	-	Shreds oversize bulky waste prior to landfill	UC	CO
North Dade County	Projected 1981	Two horizontal shredders	40 each	-	Preshred bulky items before processing steam for electricity	UC	CO
Lakeland	Projected 1981	One nonreversible shredder	40	-	Supplemental boiler fuel	UC	MU
Georgia							
Atlanta	1976	One Horizontal shredder	60	250	Shreds prior to baling	OP	MU
DeKalb County	1973	Two vertical shaft shredders	40 each	500	Shreds prior to landfill	OP	CO
Illinois							
Chicago	1976	Two horizontal primary shredders; two vertical secondary shredders	75 each; 60 each	-	Recovery	NOP	MU
Chicago	1970	One horizontal shredder	25	-	Shreds bulky wastes prior to incineration	OP	MU
LaMont	1975	One vertical shredder	25	-	Ferrous recovery	OP	PR
Springfield	1980	One shear-type shredder	40-60	-	Landfill	OP	PR
Indiana							
East Chicago	1977	One horizontal shredder	25	100	Shreds bulky wastes prior to landfill	OP	MU
Iowa							
Ames	1975	Two horizontal shredders	-	175-200	RDF	OP	MU
Kansas							
McPherson	1975	One vertical shredder	15	-	Shreds wastes prior to landfill	OP	-

VI-5 (CONTINUED)

Kentucky							
Louisville	1964	One horizontal shredder	20	-	Shreds oversized wastes prior to incineration	NOP	MU
Louisiana							
New Orleans	1976	One vertical shredder	60	-	-	OP	PR
St. Mary's Parish	1979	Two vertical shaft shredders	20 each	-	Landfill	OP	CO
Vermillion Parish	1978	Two horizontal shredders	40 60	-	Landfill	OP	MU
Maine							
Lewiston	1977	One vertical shredder	30	140	Landfill; ferrous recovery but no markets	OP	MU
Maryland							
Cockeysville	1975	Two horizontal shredders	60 each	850	Landfill; ferrous recovery; RDF	OP	CO
Massachusetts							
East Bridgewater	1977	One horizontal shredder	40	-	Produces and tests Eco-Fuel II	OP	PR
North Adams	-	One horizontal shredder	40	-	Shreds bulky wastes prior to landfill	OP	MU
Holliston	1974	One non-reversible shredder	50	-	Shreds bulky wastes prior to landfill	OP	PR
Minnesota							
St. Paul	1978	One vertical shredder	30	-	Shreds prior to landfill; ferrous recovery	OP	MU
Duluth	1980	Tow horizontal shredders	30 each	-	Used for fuel in fluidized-bed incinerator	SU	WLSSD
Missouri							
St. Louis	1969	One horizontal shredder	30	-	Shreds bulky wastes prior to incineration	OP	MU
Nebraska							
Omaha	1976	One horizontal shredder	50	-	Shreds for baling	OP	MU
New Jersey							
Monmouth County	1975	Two vertical shredders	40 each	400	Landfill with magnetic separation of ferrous	OP	CO

VI-5 (CONTINUED)

New York							
Albany	1979	Two vertical shredders	-	800	-	SKD	MU
Elmira	1973	Two horizontal shredders	40 each	-	Landfill	NOP	CO
Hempstead	1978	Four shredder-like devices called Hydrapulpers	-	1,000 (design)	Wet pulped to produce steam	NOP	PO, PROP
Jamestown	1975	Two vertical shredders	50 each	-	Shreds prior to landfill	OP	CO
Niagara Falls	1980	Three non-reversible shredders	70-90 each	-	Resource-recovery. Recovers metals, electricity, and steam	SU	PR
Rochester	1979	Seven vertical shaft shredders	Various	200-300 (approx)	Recover RDF, aluminum, metals, glass	SKD	CO, PROP
North Carolina							
Guilford County	1973	Three vertical shaft shredders	50 each	-	Shreds prior to landfill	OP	MU
Ohio							
Columbus	Under Construc-tion	Two vertical shredders	-	-	Refuse burned with pulverized coal for steam	UC	MU
Columbus	1975	Three horizontal shredders	20 each	-	Shreds prior to landfill	OP	MU
Willoughby	1973	Two vertical shredders	12 each	80-100	Shreds prior to landfill	OP	MU
Oregon							
LaGrande	1978	One vertical shaft shredder	20	-	Shreds prior to landfill	OP	MU
Lane County	1977	Two horizontal shredders	63 45	-	Recovery	OP	CO
Willsonville	1972	One vertical shaft shredder	30	-	Shreds tires prior to landfill	OP	MU
Pennsylvania							
Altoona	1965	One vertical shredder	15	-	Composting plus some ferrous recovery	OP	MU
Harrisburg	1970	One horizontal shredder	25	-	Shreds bulky wastes prior to incineration	OP	MU
South Carolina							
Beaufort	1975	One vertical shredder	20	-	Landfill; some ferrous recovery	OP	MU

VI-5 (CONCLUDED)

	Charleston	1974	Three horizontal shredders	30 each	-	Landfill; some ferrous recovery	OP	MU
	Georgetown County	1974	One vertical shredder	20	-	Landfill; some ferrous recovery	OP	MU
	Williamsburg	1973	One vertical shredder	20	-	Landfill; some ferrous recovery	OP	CO
South Dakota								
	Aberdeen	1975	One vertical shredder	20	-	Shreds bulky wastes prior to landfill	OP	MU
Texas								
	Houston	1965	One horizontal shredder	40	-	Shredded for ferrous recovery, remainder landfill	OP	MU
	Odessa	1974	One horizontal shredder	50	-	Recovers metals and soil enrichment	OP	MU
	Texarkana	1977	One horizontal shredder	20	-	Process industrial wastes prior to landfill; ferrous recovery	OP	PR
Virginia								
	Norfolk	1975	One horizontal shredder	30	-	Shred bulk wastes	NOP	Navy
Washington								
	Cowlitz County	1976	One horizontal shredder	50	-	Shreds prior to landfill	OP	CO
	Tacoma	1971	One horizontal shredder	40	-	Landfill and RDF	OP	MU
Wisconsin								
	Appleton	1974	Two horizontal shredders	15 each	-	Shreds prior to landfill	OP	MU
	Madison	1967	Flail Mill; one vertical shredder	35	-	Landfill and RDF	OP	MU
	Milwaukee	1976	Two horizontal primary shredders; two vertical secondary shredders	75 60	1,600 (design)	Fullscale resource recovery including RDF ferrous, glass and aluminum	OP	PR

Abbreviations:
OP = Operational
NOP = Not Operational
UC = Under Construction
PR = Private Owner
MU = Municipal Owner
SKD = Shakedown
CO = County Owner
PROP = Private Operator
SO = State Owner
SU = Start-up
WLSSD= Western Lake Superior Sanitary District

Source: 47

VI-6 SHREDDER FACILITY COSTS

	1975 Costs[1]		1980 Costs[2]
	Average	Range	Average
Capital Costs	$1.94 million	$0.64-5.26 million	$2.88 million
Annual Costs			
Operating Costs	$5.61/Ton	$2.85-9.50/Ton	$8.63/Ton
Annualized Capital Costs	$1.69/Ton	$0.80-3.10/Ton	$2.51/Ton
Total Annual Costs	$7.30/Ton	$3.91-11.54/Ton	$11.14/Ton

[1]Based on 10 shredders (1975) with capacities ranging from 64-1,042 TPD, annualized capital costs do not include interest costs.

[2]1980 cost updates were prepared by JRB Associates using the Marshall and Stevens Index as published in the Chemical Engineering Magazine for capital and annualized capital costs and the Municipal Cost Index (MCI) published by The American City and County Magazine for operating costs.

Source: 34

VI-7 TRANSFER SYSTEM COSTS

	1975 Costs[1]		1980 Costs[2]
	Average	Range	Average
Capital Costs	$0.78 million	$0.13-3.68 million	$1.16 million
Annual Costs			
Operating Costs	$4.55/Ton	$1.84-10.72/Ton	$7.00/Ton
Annualized Capital Costs	$0.94/Ton	$0.15-2.70/Ton	$1.40/Ton
Total Annual Costs	$5.49/Ton	$2.31-12.18/Ton	$8.40/Ton

[1]Based on 12 transfer systems (1975) with capacities ranging from 112-880 TPD, annualized capital costs do not include interest costs.

[2]1980 cost updates were prepared by JRB Associates using the Marshall and Stevens Index published in the Chemical Engineering Magazine for capital and annualized capital costs and the Municipal Cost Index published by The American City and County Magazine for operating costs.

Source: 34

VI-8 TRANSFER STATION USAGE, 1974

	# Cities Reporting (A)	Using Transfer Stations		Operating Authority			
				Municipal		Non-municipal	
		#(B)	% of (A)	#	% of (B)	#	% of (B)
TOTAL	1,022	136	13	59	43	77	57
Population Group							
500,000+	14	6	43	4	67	2	33
250,000-499,999	18	5	28	2	40	3	60
100,000-249,999	65	14	22	8	57	6	43
50,000- 99,999	150	28	19	11	39	17	61
25,000- 49,999	253	35	14	16	46	19	54
10,000- 24,999	522	48	9	18	38	30	62

Source: 33

VII. Disposal

VII-1 MUNICIPAL SOLID WASTE DISPOSAL BY METHOD

Disposal Method	Number of Facilities	% Disposed[1]
Landfill	12,627[2]	96
Incineration		4
without energy recovery	77[3]	
with energy recovery	41[3]	

[1] Net discards (excluding materials recovery) in 1978. (Source 42)
[2] Based on 1980 survey of 48 states. Not limited to municipal solid waste landfills. (Source 46)
[3] Number of facilities in 1978. (Source 13).

Sources: 13, 42, 46

VII-2 AVERAGE DISPOSAL COSTS BY CITY SIZE

Population Group	Dollars per Ton[1]	
	1974	1980
>500,000	$7.60	$12.24
250,000-499,999	8.61	13.86
100,000-249,999	6.62	10.66
50,000-99,999	4.26	6.86
25,000-49,999	3.15	5.07
10,000-24,999	4.67	7.52
2,500-9,999	3.92	6.31
Total	$4.62	$7.44

Data from NSF survey, sample size of 177.

[1] 1974 costs escalated to 1980 by JRB Associates using the Municipal Cost Index (MCI) published by The American City and County Magazine.

Source: 42

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VII-3 ESTIMATED COSTS FOR MUNICIPAL SOLID WASTE INCINERATION, 1980

Incineration	Cost ($/ton)[1] 1978	1980
Without Energy Recovery[2]	25.00-35.00	30.76-43.06
With Steam Recovery[3]	13.03-26.27	16.03-32.32

[1] 1978 costs provided to EPA by Franklin Associates, Ltd., escalated to 1980 by JRB Associates using the Municipal Cost Index (MCI) published by The American City and County Magazine.
[2] Includes amortization and operating costs.
[3] $16.03/Ton for 500 TPD plant, $32.31/Ton for 50 TPD plant. Includes credit for energy revenues.

Source: 42

VII-4 BREAKDOWN OF SANITARY LANDFILL CAPACITY, 1980

Facility Capacity (TPD)	Number of Facilities[1] (in 23 states)	Percent of Total
0-50	6,279	81.3
50-100	450	5.8
100-200	370	4.8
200-500	370	4.8
500-1000	164	2.1
>1000	91	1.2
TOTAL	7,724	100

[1] Only 23 of the 50 states responded to this question in the Waste Age Magazine 1980 Land Disposal Survey. The facilities account for 61.2 percent of the total reported in the survey.

Source: 46

VIII. Rural Waste

VIII-1 COMMUNITY SIZE AND PERCENT OF STRUCTURES SERVICED, 1979

Community Size	Structure Type		
	Residential	Commercial	Industrial
Incorporated			
25,000-50,000	85%	35%	38%
10,000-24,999	83%	50%	40%
5,000-9,999	92%	68%	72%
2,500-4,999	67%	67%	54%
0-2,499	83%	83%	67%
Unincorporated			
0-50,000	37%	29%	25%

Data from survey of 40 communities.

Source: 1

VIII-2 COLLECTION EQUIPMENT AND COMMUNITY SIZE, 1979

	Percent Communities Using Equipment[1]				
	Rear Loaders	Front Loaders	Side Loaders	Other Trucks	Dumpsters, Greenboxes
Incorporated					
25,000-50,000	67	-	-	33	67
10,000-24,999	60	-	-	-	20
5,000-9,999	67	33	-	17	67
2,500-4,999	57	-	57	33	29
0-2,499	67	17	-	50	83
Unincorporated					
0-50,000	22	33	-	44	11

Data based on survey of 40 communities.

[1] More than one type of equipment may be used by each community. Percent reflects number of communities in each category that use each equipment type.

Source: 1

VIII-3 ENVIRONMENTAL MANAGEMENT CONTROLS FOR RURAL SANITARY LANDFILLS, 1979

Community Size	Percent Applying Control		
	Leachate Control	Decomposition Gas Control	Runoff Control
Incorporated			
25,000-50,000	67	33	67
10,000-24,999	60	60	60
5,000-9,999	67	30	80
2,500-4,999	0	0	17
0-2,499	0	0	20
Unincorporated			
0-50,000	22	11	56

Data based on survey of 40 communities.

Source: 1

VIII-4 USE OF LANDFILL SOIL COVER BY RURAL COMMUNITY SIZE, 1979

Community Size	Type of Soil Cover		
	≥6 inches daily	≥6 inches every other day	Less often than every other day
Incorporated			
25,000-50,000	X		
10,000-24,999	X		
5,000-9,999	X		
2,500-4,999	X	X	X
0-2,499	X		
Unincorporated			
0-50,000	X	X	X

Data based on a survey of 40 communities (required to respond only in affirmative).

Source: 1

TABLE VIII-5 INITIAL CAPITAL INVESTMENT FOR "GREEN BOX" CONTAINER SYSTEM FOR COMMUNITY OF 15,000

Item	Approximate Cost[1]
2, 41yd^3 Front Loading Compactor Trucks @ 96,000	$192,000
186, 8yd^3 "Green Boxes", @$600	111,600
Maintenance/Welding Equipment	10,000
TOTAL	$313,600

Assumes once per week collection and that average number of persons served per yd^3 of container space is 10.1. Guidance on system requirements from Source 35.

[1]Cost information from Source 25. Does not include land costs.

Sources: 25, 35

IX. Resource Recovery

IX-1 RESOURCE RECOVERY FACILITIES BY TECHNOLOGY, 1981

	Operating	Suspended Operation	Under Construction[1]	Total
RDF	5	9	6	20
Mass Burning	11	1	5	17
Modular Incineration	8	3	10	21
Co-Disposal	1	1	1	3
Pyrolysis	0	1	1	2
TOTAL	25	15	23	63

Data compiled by JRB Associates.

[1]Includes those facilities undergoing modification and shake-down

Source: 13

IX-2 OPERATING RESOURCE RECOVERY FACILITIES BY CAPACITY, 1981

	RDF	Mass Burn	Modular	Co-Disposal	Pyrolysis	Total
0-100	0	2	9	0	0	11
100-250	1	3	2	0	0	6
250-500	3	2	0	1	0	6
500-1000	4	2	0	1	1	8
1000-2000	5	3	0	0	0	8
2000+	1	0	0	0	0	1
TOTAL	14	12	11	2	1	40

Includes those facilities with suspended operation. Data compiled by JRB.

Source: 13

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IX-3 COMPARISON OF RESOURCE RECOVERY TECHNOLOGIES

	Modular Incinerators	Mass-Burning Refractory Incinerators	Mass-Burning Waterwall Incinerators	RDF-Fired Boilers
Typical Unit Capacity (Tons/Hour)	0.5-6.25	6.25-10.4	3.3-43.75	12.5-39[1]
Existing System Capacities (Tons/Day)	5-240	350-1000	160-2100	600-2000
Typical Procurement Approach	Modified Full Service (MFS)	A/E	MFS	MFS
Construction Lead Time (Months)	15-24	30-42	30-42	30-42
Major Equipment Lifetime (Years)[2]	15	20	20	20
Overall Boilers Efficiency (Steam)	50-60	50-60	65-70	70-75[1]
Max. Steam Characteristics a) lbs/hour/unit output b) psig/°F	 31,000 175/465	 31,500 450/500	 265,000 615/750	 190,000[1] 625/750[1]
Electrical Generation Potential (Kwh/Ton)[3]	250-350	250-350	450-550	450-550[1]
Inplant Electrical Usage (Kwh/Ton)	25-50	25-40	60-70	110[4]
Auxiliary Fuel Use (MBTU's/Ton)	250-400	Min	Min	Min
Typical Emission Control Device	Afterburners[5]	ESP	ESP	ESP
Est. Capital Cost ($/Design TPD)	$30-40,000	$45-55,000	$45-55,000	$50-60,000

[1] Figures are for dedicated systems only (no co-firing units).
[2] This lifetime is frequently assumed for calculating bondlife, however, not enough operating data exists to yet decide this figure.
[3] Exclusive of inplant usage.
[4] Includes energy for RDF production.
[5] Although past systems used only afterburners, recently planned systems (mostly larger systems) are calling for further APC such as fabric filters or electro-scrubbers.

Source: 12

IX-4 ENERGY PRODUCTIVITY COMPARISON OF RESOURCE RECOVERY SYSTEMS

	Waterwall Combustion: Unprocessed	Shredded	RDF	Modular Incinerators	RDF Production
Energy Input (Btu per pound refuse)	4,300	4,300	4,300	4,300	4,300
Energy Requirements and Losses (Btu per pound refuse)					
• Refuse fuel processing:					
- Electrical requirements	-	190	240	-	240
- Loss of combustible	-	680	900	-	900
• Energy conversion facility:					
- Fossil Fuel and electrical requirements	120	120	70	330	70
- Heat loss	1,670	1,160	1,110	1,710	1,110
• Transportation:					
- Residues	10	20	20	10	20
- Refuse derived fuel	-	-	-	-	10
Total	1,800	2,170	2,340	2,050	2,350
Net System Output (Btu per pound refuse)	2,700	2,330	2,160	2,450	2,150
Energy Productivity Ratio	60%	52%	48%	54%	48%

Source: 45

IX-5 RESOURCE RECOVERY FACILITIES, 1981

Location	Technology	Design Capacity	Products	Capital Costs (million $)	Start-up Date	Status April 1981
OPERATING FACILITIES						
Arkansas						
Blythville	MCU	50	Steam	0.8	1975	SO
North Little Rock	MCU	100	Steam	1.45	1977	OP
Osceola	MCU	50	Steam	1.1	1980	OP
Connecticut						
Bridgeport	RDF	1800	Eco-Fuel II; Ferrous, Non-ferrous metals; Glass	53	1980	SO
Florida						
Mayport (Naval Base)	RLF	50	Steam	1.0	1979	OP
Illinois						
Chicago (Northwest Incinerator)	MWC	1600	Steam; Ferrous metals	23	1971	OP
Chicago (Southwest Supplementary Fuel Processing Facility)	RDF	1000	RDF; Ferrous metals	19	1977	SO
Iowa						
Ames	RDF	200	RDF; Ferrous, Non-Ferrous metals; Glass	6.2	1975	OP
Louisiana						
New Orleans	Materials Recovery	750	Ferrous, Non-Ferrous metals; Glass	9.1	1978	OP
Maryland						
Baltimore	Pyrolysis	600	Steam	10	-	SD/M
Baltimore County	RDF	1200	RDF; Ferrous metals; Glass; Aluminum	8.4	1976	OP
Massachusetts						
Braintree	MWC	384	Steam	2.8	1971	OP
East Bridgewater	RDF	360	Eco-Fuel II; Ferrous	10-12	1977	SO
Pittsfield	MCU	240	Steam	6.2	1981	OP
Saugus	MWC	1500	Steam; Ferrous metals	50	1975	UM
Michigan						
Genesee Township	MCU	100	Steam	2	1980	SO
Minnesota						
Duluth	Co-disposal	400 MSW, 140 Sludge	RDF; Ferrous metals; Steam	19	1980	UM
New Hampshire						
Durham	MCU	180	Steam	3.3	1980	OP
Groveton	MCU	24	Steam	N/A	1975	OP
New York						
Albany	RDF	750	RDF: Ferrous, Non-Ferrous metals; Steam	26.6	1980	OP

IX-5 (Continued)

Hempstead	RDF	2000	Electricity; Glass; Aluminum; Ferrous metals	130	1978	SO
Monroe County	RDF	2000	RDF; Ferrous, Non-Ferrous metals; Glass	62.2	1979	OP
New York (Betts Ave. Incinerator)	RLF	1200	Steam	24[2]	1965	OP
Niagara Falls	RDF	2200	Steam; Electricity; Ferrous metals	74	1981	SKD
Oceanside	MWC	750	Steam	9	1974	OP
Ohio						
Akron	RDF	1000	Steam; Ferrous metals	55	1980	UN
Oregon						
Lane County	RDF	500	RDF; Ferrous metals	2.1	1979	UN
Pennsylvania						
Harrisburg	Co-disposal	720	Steam; Ferrous metals	8.3	1972	OP
Tennessee						
Crossville	MCU	60	Steam	1.1	1978	FS
Dyersville	MCU	100	Steam	2	1980	OP
Lewisburg	RLF	60	Steam	N/A	1989	SKD
Nashville	MWC	530	Steam	24.5	1974	OP
Virginia						
Hampton	MWC	200	Steam	10.3	1980	OP
Newport News	MCU	40	Steam	1.4	1981	OP
Norfolk (U.S. Naval Station)	MWC	360	Steam	2.2	1967	OP
Portsmouth (Norfolk Naval Shpyd)	MWC	160	Steam	4.5	1976	OP
Salem	MCU	100	Steam	1.9	1979	OP
Washington						
Tacoma	RDF	1000	RDF; Ferrous metals	2.5	1979	SO
Wisconsin						
Madison	RDF	400	RDF; Ferrous metals	2.5	1979	OP
Milwaukee	RDF	1600	RDF; Ferrous metals	18	1977	SO
Waukesha	RLF	175	Steam	1.7-1971 3.9-1979	1979	OP
UNDER CONSTRUCTION						
Arkansas						
Batesville	MCU	50	Steam	1.07	4/81	CN
Connecticut						
Windham	MCU	108	Steam	3.7	8/81	CN
Delaware						
Wilmington	RDF/Co-disposal	1000	RDF; Ferrous, Non-Ferrous metals; Glass; Humus	71.3	1982	CN
Florida						
Dade County	RDF	3750	Steam; Aluminum; Ferrous metals	165	7/81	CN
Lakeland	RDF	300	Steam; Ferrous metals	5	10/81	CN
Orange County (Walt Disney World)	Slagging Pyrolysis	100	High temperature water	15	1982	CN
Pinellas County	MWC	2000	Electricity; Ferrous, Non-Ferrous metals	160	1983	CN

IX-5 (Continued)

Idaho						
Heyburn	MCU	50	Steam	1.5	Late '81	CN
Kentucky						
Fort Knox	MCU	40	Steam	1.9	1982	CN
Maine						
Auburn	MCU	200	Steam	3.97	4/81	CN
Massachusetts						
North Andover	WWC	1500	Electricity	70	1985	AP
Michigan						
Detroit	RDF	3000	Steam; Ferrous metals; Electricity	150	1984	AP
Minnesota						
Collegeville	MCU	70	Steam	2.5	9/81	CN
Redwing	MCU	72	Steam	2.5	1982	CN
Missouri						
Ft. Leonard Wood	MCU	75	Steam	2.2	1982	CN
New York						
Glen Cove	Co-disposal	225	Steam; Electricity	22[3], 12[4]	1982	CN
Westchester County	WWC	1500	Steam; Electricity	100	1984	AP
Ohio						
Columbus	RDF	2000	Electricity	152	1982	CN
Tennessee						
Gallatin	Rotary Combustor	200	Steam; Electricity	8.1	10/81	CN
Texas						
Gatesville	MCU	4	Steam	0.2	Spring '81	CN
Palestine	MCU	20	Steam	0.3	Spring '81	CN
Vermont						
Burlington	Stoker-fired furnace	120	Hot water	120	1983	FS
Virginia						
Portsmouth (Southeastern Tidewater Energy Project)	RDF	2000	RDF; Electricity; Ferrous, Non-Ferrous metals	70	1986	AP

[1] 20% solids
[2] 1980 modification
[3] RLF
[4] Sewage plant

Abbreviations:
MCU = Modular Combustion Units
RDF = Refuse-Derived Fuel
WWC = Water-Walled Combustion
RLF = Refraction Lined Furnace
SO = Suspended Operation
OP = Operating
SD/M = Shut Down for Modification
UM = Under Modification
SKD = Shake-Down
FS = For Sale
CN = Construction
AP = Advanced Plan
FS = Financing Secure

Source: 13

IX-6 RECYCLABLE MATERIALS AS PERCENT OF TOTAL RESIDENTIAL WASTE, 1980

Materials	Percentage of Total Waste
Paper	30-40
Newsprint	9-15
Magazine	1-3
Corrugated	1-2
Other	19-20
Glass, Beverage	7-16
Clear	4-9
Green	2-4
Brown	1-3
Glass, Other	6.5-10
Clear	5-6
Green	1-3
Brown	0.5-1
Ferrous, Beverage	0.5-2
Ferrous, Other	3-5
Aluminum, Beverage	0.1-1
Aluminum, Other	0.1-1
Non-Recyclable Refuse	52.8-25

Source: 41

IX-7 ENERGY SAVINGS THROUGH RECYCLING OF WASTE MATERIALS

	Energy Savings 10^6 Btu/Ton		Percent Savings[1]	
	Est.[2]	Range[3]	Est.[2]	Range[3]
Ferrous Metals	15.5	7.0-42.2	65	50-74
Aluminum	224	169-281	92	92-97
Copper	94.7	40.3-94.7	85	84-95
Lead	17.5	5.5-17.5	65	56-65
Zinc	39.3	11.8-47.0	60	60-72
Paper/Newspaper	35.5	5.2-35.5	64	23-70
Glass	-	1.3-2.5	-	0-14
Rubber	22.1	22.0-22.1	71	11-18

Data compiled by JRB Associates.

[1] Realized savings resulting from use of recycled materials as compared with total energy expended in refining new materials.
[2] From the National Association of Recycling Industries.
[3] Estimated range from various sources.

Source: 23

IX-8 TWENTY-SIX OPERATING WASTE EXCHANGES IN THE U.S., 1981

California
- Berkeley - California Waste Exchange
- Oakland - Zero Waste Systems, Inc.

Connecticut
- Waterbury - World Association for Safe Transfer and Exchange (WASTE)

Georgia
- Atlanta - Georgia Waste Exchange

Illinois
- Hazel Crest - Environmental Clearinghouse Organization (ECHO)
- Skokie - American Chemical Exchange (ACE)
- Springfield - Industrial Material Exchange Service

Indiana
- Indianapolis - Waste Materials Clearinghouse
- Indianapolis - Environmental Quality Control, Inc.

Iowa
- Ames - Iowa Industrial Waste Information Exchange

Massachusetts
- Boston - The Exchange

Michigan
- Detroit - American Materials Exchange Network

Minnesota
- St. Paul - Minnesota Association of Commerce and Industry (MACI)

Missouri
- St. Louis - Midwest Industrial Waste Exchange
- Kansas City - Chamber of Commerce of Greater Kansas City

New Jersey
- Newark - Industrial Waste Information Exchange

New York
- Albany - Enkarn Research Corporation
- Albany - The American Alliance of Resource Recovery Interests, Inc. (AARRII)

North Carolina
- Charlotte - Mecklenburg County Waste Exchange

Ohio
- Cleveland - The Ohio Resource Exchange
- Columbus - Industrial Waste Information Exchange

Oregon
- Portland - Oregon Industrial Waste Information Exchange

Pennsylvania
- Harrisburg - Pennsylvania Waste Information Exchange

Tennessee
- Nashville - Tennessee Waste Swap

Texas
- Houston - Chemical Recycle Information Program

Washington
- Seattle - Information Center of Waste Exchange

West Virginia
- South Charleston - Union Carbide Corporation (In-house operation only)

Source: 19

IX-9 NUMBER OF PROGRAMS COLLECTING SPECIFIC RECYCLABLES, 1981

	Number of Programs	Percentage
Total Programs	229	100
Paper	229	100[1]
Glass	59	26
Metal	48[2]	21

[1]Approximately 75% of the paper programs collect newspaper only, while the other 25% collect mixed wastepaper (80% of newspaper by weight).
[2]Four collect aluminum only and 1 collects ferrous only.

Source: 13

IX-10 SOURCE SEPARATION COLLECTION RESPONSIBILITIES, 1981

	Number of Programs	Percentage
Public	143	62.4
Private	65	28.4
Non-Profit	21	9.2
TOTAL	229	100.0

Data compiled by JRB Associates.

Source: 13

IX-11 WASTE PAPER UTILIZATION, 1970 TO 1980

Year	Domestic Production (000 tons)	Total Waste Paper Utilized[1] (000 tons)	Total Waste Paper Utilized[1] (percent)	Mixed (000 tons)	News (000 tons)	Corrugated (000 tons)	Pulp Substitutes (000 tons)	High Grade Deinking (000 tons)
1970	53,173	12,021	22.6	2,639	2,235	4,080	2,216	851
1971	54,921	13,323	22.4	2,775	2,174	4,277	2,206	891
1972	59,358	13,132	22.1	3,054	2,317	4,722	2,188	852
1973	61,937	14,318	23.1	3,251	2,578	5,291	2,252	946
1974	61,086	14,196	23.2	3,118	2,408	5,716	2,062	892
1975	52,827	11,983	22.7	2,606	2,040	4,743	1,792	803
1976	60,495	13,822	22.8	2,798	2,278	5,696	2,117	933
1977	62,306	14,288	22.9	2,773	2,287	6,205	2,079	944
1978	64,403	14,972	23.2	2,729	2,212	6,721	2,242	1,068
1979	66,679	15,520	23.3	2,650	2,478	6,967	2,308	1,117
1980	65,204	14,667	22.5	2,465	2,375	6,939	1,945	942

[1] Includes waste paper used in wet machine board and molded pulp products.

Sources: 4, 5, 21

IX-12 TOTAL QUANTITIES OF RECYCLED MATERIALS, 1980

Material	Amount (thousand tons)	% of total production
Aluminum[1]	610	12.2
Copper[1]	639	31
Ferrous metals	19920	18
Glass	375[2]	2.3
Paper	17627[3]	25.6
Rubber	140[3]	4.7[2]

[1] Includes post-consumer scrap, such as automobiles, beverage cans, cooking utensils, obsolete machinery, etc.
[2] 1978 data.
[3] Amount of recycled paper utilized in industry plus exports plus other uses minus imports.

Sources: 4, 5, 6, 8, 10

IX-13 LIST OF SOURCE SEPARATION PROGRAMS AS OF FEBRUARY, 1981

	Materials Collected			Collection Method		Collection Responsibility	Mandatory Ordinance
	P	G	M	Sep	Simul		
ARIZONA							
Tucson	X				R	Pub	
CALIFORNIA							
Berkeley	X	X	X	X		NP	
Chico	X	X	X	X		NP	
Davis	X	X	X	X		Pri	X
Downey	X	X	X	X		Pri	
El Cerrito	X	X	X	X		Pub	
Eureka	X				R	Pri	
Fresno/Clovis	X	X	X	X		Pub	
Fullerton	X				R	Pri	
Isla Vista	X	X	AL	X		NP	
Livermore	X	X	X	X		Pri	
Marin Co.	X	X	X	X		Pri	
Merced	X	X	X	X		NP	
Modesto	X	X	X	X		NP	
Newport Beach	X			X		Pub	
Ojai	X			X		NP	
Ontario	X			X		Pub	
Pacifica	X				R	Pri	
Palo Alto	X	X	X	X		Pub	
Placer Co.	X				R	Pri	
Sacramento	X				R	Pub	
Sacramento Co. (unicorp. area)	X				R	Pub	
San Bernadino	X				R	Pub	X
San Francisco	X				R	Pri	
San Luis Obispo	X	X	X	X		Pri	
Santa Barbara	X			X		NP	
Santa Maria	X				R	Pub	
Santa Rosa	X	X	X	X		Pri	
COLORADO							
Boulder	X	X	X	X		NP	
Englewood	X	X	X	X		NP	
Littleton	X	X	X	X		NP	
CONNECTICUT							
Berlin	X			X		Pub	
Bloomfield	X			X		Pri	
Cornwall	X	X		X		Pri	
Durham/Middlefield	X	X		X		Pri	
East Hartford	X				T	Pub	X
East Lyme	X	X	X		T	Pub	X
Enfield	X				T	Pub	
Groton (city)	X			X		Pub	
Groton (town)	X	X	X	X		Pub	X
Hamden	X			X		Pub	
New Britain	X	X	X		T	Pri	
New Haven	X			X		Pub	
New London	X	X	X		T	Pub	
Newington	X				R	Pri	
Norwalk	X			X		Pub	X
Rocky Hill	X			X		Pub	
South Windsor	X				R	Pri	
Stamford	X			X		Pub	X
Waterford	X				T	Pub	

TABLE IX-13 (CONTINUED)

	Materials Collected			Collection Method		Collection Responsibility	Mandatory Ordinance
	P	G	M	Sep	Simul		
West Hartford	X			X		Pub	
Wethersfield	X				R	Pri	X
Winchester	X	X	X	X		Pub	
FLORIDA							
Boca Raton	X			X		Pub	
Ft. Meyers	X				T	Pub	
Highland Beach	X			X		Pri	
Lake Park	X			X		Pub	
Leesburg	X			X		Pub	
Madeira Beach	X			X		Pub	
N Miami Beach	X			X		Pri	
N Palm Beach	X			X		Pub	
Palm Beach	X			X		Pub	
Palm Springs	X			X		Pub	
Tamarack	X			X		Pri	
Temple Terrace	X				R	Pub	
Titusville	X			X		Pub	
Vero Beach	X			X		Pub	
W Palm Beach	X			X		Pub	
GEORGIA							
Ashburn	X			X		Pub	
Avondale Estates	X				R	Pub	
Brunswick	X			X		Pub	
De Kalb Co. (unincorp. area)	X				R	Pub	
East Point	X				R	Pub	
Rome	X				R	Pub	
Tifton	X				R	Pub	
ILLINOIS							
Rockford	X				R	Pri	
Rolling Meadows	X				R	Pub	
INDIANA							
Bloomington	X			X		NP	
Greencastle	X			X		NP	
Munster	X			X		Pub	
Speedway	X			X		NP	
KENTUCKY							
Saint Mathews	X				R	Pub	
MAINE							
Brunswick	X	X		X		Pub	
MARYLAND							
Glen Echo	X			X		Pri	X
Greenbelt	X			X		Pub	X
Montgomery Co. (unicorp. area)	X		Al	X		Pri	X
Rockville	X			X		Pub	X
Somerset	X			X		Pri	X
MASSACHUSETTS							
Andover	X	X		X		Pri	
Arlington	X			X		Pub	

TABLE IX-13 (CONTINUED)

	Materials Collected			Collection Method		Collection Responsibility	Mandatory Ordinance
	P	G	M	Sep	Simul		
Bedford	X	X		X		Pri	
Braintree	X	X		X		Pri	
Buckland	X				R	Pub	
Chelmsford	X			X		Pub	
Dartmouth	X			X		Pub	
Franklin Co.	X	X		X		NP	
Longmeadow	X	X		X		Pub	
Marblehead	X	X	X	X		Pub	X
Monroe Bridge	X	X	X	X		Pub	
Newton	X	X	X	X		Pub	X
N. Andover	X			X		Pub	
Southbridge	X	X		X		Pri	
Waltham	X			X		Pub	
Webster	X	X		X		Pri	
Weymouth	X			X		Pub	
MICHIGAN							
Birmingham	X				R	Pub	
Huntington Woods	X			X		NP	
MINNESOTA							
Mankato	X				R	Pri	
N Mankato	X				R	Pri	
MISSOURI							
University City	X			X		Pub	
MONTANA							
Helena	X				R	Pub	
NEW JERSEY							
Bergenfield	X			X		Pub	X
Berlin	X	X		X		Pub	
Bound Brook	X		X	X		Pub	
Caldwell	X			X		Pri	X
Closter	X			X		Pub	X
East Orange	X			X		Pri	
Englewood	X			X		Pub	
Flemington	X	X	X	X		Pub	
Glen Rock	X			X		Pub	X
Hackensack	X			X		Pub	
Kenilworth	X		Al	X		Pub	
Lebanon Twp.	X		X	X		NP	
Metuchen	X			X		Pub	
Millburn	X			X		Pri	X
Monmouth Co.	X			X		NP	X
Montclair	X	X		X		Pub	X
N Brunswick	X			X		Pub	
Ocean	X			X		Pri	
Paramus	X			X		Pri	X
Pennington	X	X	Al	X		Pri	
Princeton Boro	X	X		X		Pri	
Raritan	X			X		Pri	X
Ridgewood	X			X		Pub	
River Edge	X			X		Pri	
Ringwood	X			X		Pub	X
Rutherford	X			X		Pub	
Saddle River	X			X		Pri	X

TABLE IX-13 (CONTINUED)

	Materials Collected			Collection Method		Collection Responsi-bility	Mandatory Ordinance
	P	G	M	Sep	Simul		
Somerville	X			X		Pri	X
Tenafly	X			X		Pub	X
Union City	X			X		Pri	X
West Orange	X			X		Pri	
Wharton	X	X		X		Pub	
Woodbury	X	X	X	X		Pub	X
NEW YORK							
Ardsley	X			X		Pri	
Batavia	X	X	X	X		Pub	
Bayville	X			X		Pub	X
Briarcliff	X			X		Pub	
Buchanan	X			X		Pub	
Carmel	X			X		Pub	
Cheektowaga	X	X	X	X		NP	
Cortlandt	X			X		Pub	
Dobbs Ferry	X			X		Pri	X
East Hills	X			X		Pub	X
Elmsford	X				R	Pub	
Floral Park	X			X		Pub	X
Flower Hill	X			X		Pri	
Garden City	X			X		Pub	X
Glen Cove	X			X		Pub	X
Great Neck	X			X		Pub	X
Hastings	X			X		Pub	
Irvington	X			X		Pub	
Islip	X	X	X	X		Pri	X
Larchmont-Mamaroneck	X			X		Pub	
Mamaroneck (vill)	X			X		Pub	
Mineola	X			X		Pub	
Mount Kisco	X			X		Pri	
Mount Vernon	X			X		Pub	
N Tarrytown	X			X		Pub	
Ossining (town)	X			X		Pub	X
Ossining (vill)	X			X		Pub	X
Oyster Bay	X				R	Pub	X
Pelham	X			X		Pub	X
Pelham Manor	X			X		Pub	X
Pleasantville	X			X		Pri	
Port Chester	X			X		Pub	
Ramapo	X			X		Pub	
Rockville Center	X			X		Pub	
Roslyn	X			X		Pub	
Scarsdale	X			X		Pub	
Rye	X			X		Pub	
Sea Cliff	X			X		Pub	
Tarrytown	X			X		Pub	
Tuckahoe	X			X		Pub	
Westbury	X			X		Pub	
White Plains	X			X		Pub	X
Williston Park	X	X		X		Pub	
OHIO							
Golf Manor	X	X	X	X		Pub	
OREGON							
Ashland	X				R	Pri	
Canby	X	X	X	X		Pri	

TABLE IX-13 (CONTINUED)

	Materials Collected			Collection Method		Collection Responsi-bility	Mandatory Ordinance
	P	G	M	Sep	Simul		
Corvallis	X	X	X	X	R	Pri	
Lake Oswego	X	X	X	X		Pri	
McMinnville	X	X	X	X		Pri	
Newburg	X	X	X	X		Pri	
Oregon City	X	X	X	X		Pri	
Prineville	X				R	Pri	
Salem	X	X	X	X		Pri	
Sheridan	X	X	X	X		Pri	
Springfield	X				R	Pri	
Washington Co.	X				R	Pri	
PENNSYLVANIA							
Abington	X	X		X		Pub	X
Clifton Heights	X			X		Pub	
Columbia Co.	X	X	X	X		NP	
Haverford	X			X		Pub	
Spring City	X	X	X	X		Pub	
RHODE ISLAND							
Barrington	X	X		X		Pub	X
Bristol	X				R	Pub	X
TEXAS							
El Paso	X		Fe	X		Pub	
University Park	X			X		Pub	
VIRGINIA							
Alexandria	X			X		Pub	X
Arlington Co. (unincorp. area)	X			X		Pub	
Fairfax City	X			X		Pub	
Fairlington	X			X		NP	
Falls Church	X			X		Pub	X
Herndon	X			X		Pub	
Vienna	X			X		Pub	X
Winchester	X			X		NP	
WISCONSIN							
Boscobel	X			X		Pub	
Columbus	X			X		Pub	
Eau Claire/Altoona	X		X	X		Pri	
Ft. Atkinson	X				R	Pri	
Glendale	X				R	Pub	
Madison	X				R	Pub	
Oshkosh	X				R	Pub	
Racine	X				R	Pub	
Sheboygan Falls	X				R	Pub	
Shorewood	X				R	Pub	X
Whitefish Bay	X				R	Pub	X
Wisconsin Rapids	X				R	Pub	

Abbreviations: P=Paper, G=Glass, M=Metal; Al=Aluminum, Fe=Ferrous; Sep=Separate, Simul=Simultaneous; R=Rack, T=Trailer; Pub=Public, Pri=Private, NP=Non-Profit

Source: 13

IX-14 HISTORY OF MARKET PRICES FOR SECONDARY MATERIALS

Material	1975	1976	1977	1978	1979	1980
Ferrous[1]						
No. 1. Heavy Melting	71.86	77.79	63.15	76.23	97.91	91.37[2]
No. 2. Bundles	45.00	55.20	44.11	50.26	62.89	63.74[2]
Aluminum[3]						
Old Scrap and Cast	7-8	9.5-10	13-14	15-16.5	23-24	34-35
	7-7.5	13-14	25.5-27.5	22-23	36-37	28-29
Paper[4]						
No. 1 News	20-25	35-40	40-45	40-45	30-35	45-50
Corrugated Containers	15-20	30-40	35-40	40-45	55-60	45-50

[1] Dollars per gross ton, prices are averages of No. 1 and No. 2 delivered to consumers in Pittsburgh, Philadelphia and Chicago.
[2] Estimate.
[3] Cents per pound, top row contains January prices, bottom row contains June prices. All prices are dealer's buying prices, f.o.b. New York.
[4] Dollars per ton, Board Mill Market prices f.o.b. trucks or cars at dealer's or producer's plant, prices are year averages computed by JRB Associates from Source 20.

Sources: 14, 20

X. Municipal Sludge

X-1 CHEMICAL COMPOSITION OF SEWAGE SLUDGE, ALL TYPES

Component	Quantity[1]		
	Median	Mean	Range
Organic C[2]	30.4%	31.0%	6.5-48%
Total N	3.3	3.9	<0.1-17.6
Total P	2.3	2.5	<0.1-14.3
Total S	1.1	1.1	0.6-1.5
K	0.3	0.4	0.02-2.64
Na	0.24	0.37	0.01-3.07
Ca	3.9	4.9	0.1-25.0
Mg	0.45	0.54	0.03-1.97
Ba	0.02	0.06	<0.01-0.9
Fe	1.1	1.3	<0.1-15.3
Al	0.4	1.2	0.1-13.3
Mn	260 mg/kg	380 mg/kg	18-7,100 mg/kg
B	33	77	4-760
As	10	43	6-230
Co	4.0	5.3	1-18
Mo	30	28	5-39
Hg	5	733	0.5-10,600
Pb	500	1,360	13-19,700
Zn	1,740	2,790	101-27,800
Cu	850	1,210	84-10,400
Ni	82	320	2-3,320
Cd	16	110	3-3,410
Cr	890	2,520	10-99,000

[1] Quantity of each component reported as percent by weight (%) or by weight (mg/kg)

[2] Values for NH_4-N and NO_3-N reported separately from total N:
NH_4-N: 920 ppm, median; 6,540 ppm, mean; 5-67,600 ppm, range
NO_3-N: 140 ppm, median; 490 ppm, mean; 2-4,900 ppm, range

Source: 30

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X-2 MUNICIPAL SLUDGE GENERATION, 1980

Component	Total Generation (dry kkg)		Per Capita Generation[2] (dry kkg/capital/day)
	Per day	Per year	
Sludge Generation	23,600[1]	8,600,000	0.15

[1] Derived by JRB Associates by assuming publicly owned treatment works (POTWs) operate 365 days/year.
[2] Per capita value determined using figure of 70% of U.S. population serviced by POTW/sewer systems.

Source: 36

X-3 THERMAL CONTENT OF SEWAGE SLUDGE

Type of Sewage	Thermal Content (Btu/lb)[1]	
	Range	Typical Value
Raw Primary	6,800-10,000	7,600[2]
Digested	2,700-6,800	4,000[3]
Activated	-	6,540

[1] Thermal content per lb. dry solids.
[2] Based on 65% volatile matter.
[3] Based on 40% volatile matter.

Sources: 17, 18

X-4 BREAKDOWN OF DISPOSAL METHODS FOR MUNICIPAL SLUDGE, 1980

Disposal Method	Quantity[1] (dry kkg/yr)	Percent
Thermal Process[2]	1,978,000	23
Distribution-Marketing System[3]	1,806,000	21
Land Application	2,494,000	29
-food chain land	(1,462,000)	(17)
-non-food chain land	(1,032,000)	(12)
Landfill	1,118,000	13
Other[4]	860,000	10
Ocean Dumping	344,000	4
TOTAL	8,600,000	

Data from survey of POTW's covering approximately 2.3 million dry kkg (or 27 percent of the quantity generated) and are believed to represent national practices.

[1] Calculated by JRB Associates from the percentage breakdown of disposal and the total quantity of sludge generated.
[2] Primarily incineration, includes pyrolysis.
[3] Sludge that is sold or given away. Includes processing (such as composting or heat drying) to prepare product for market.
[4] Lagoons and/or stockpiles.

Source: 36

X-5 COST OF MUNICIPAL SLUDGE DISPOSAL, 1980

Disposal Method/ Cost Component	Cost ($/dry kkg)			
	Small (<1 mgd)	Medium (1-10 mgd)	Large (10-100 mgd)	Extra Large (>100 mgd)
Landspreading				
-Capital	13	8	5	4
-O & M	57	58	50	36
-TOTAL	70	66	55	40
Landfilling				
-Capital	13	8	5	4
-O & M	47	42	25	20
-TOTAL	60	50	30	24
Incineration				
-Capital	-	85	45	30
-O & M	-	45	45	30
-TOTAL	-	130	90	60
Composting				
-Capital	20	17	12	12
-O & M	80	68	48	48
-TOTAL	100	85	60	60
Heat Treatment				
-Capital	-	44	26	17
-O & M	-	66	39	25
-TOTAL	-	110	65	42
Heat Drying				
-Capital	-	210	210	210
-O & M	-	90	90	90
-TOTAL	-	300	300	300

O & M = Operation and Maintenance

Source: 36

XI. Hazardous Waste

XI-1 ESTIMATED HAZARDOUS WASTE GENERATION BY INDUSTRY, 1980

SIC Code	Industry	Quantity (wet kkg)	Percent
22	Textile Mill Products	203,000	0.5
24	Lumber and Wood Products	87,000	0.2
25	Furniture and Fixtures	36,000	0.09
26	Paper and Allied Products	1,295,000	3.1
27	Printing and Publishing	154,000	0.4
28	Chemicals and Allied Products	25,509,000	61.9
29	Petroleum and Coal Products	2,119,000	5.1
30	Rubber and Misc. Plastic Products	249,000	0.6
31	Leather and Leather Tanning	474,000	1.1
32	Stone, Clay and Glass Products	17,000	0.04
33	Primary Metal Industries	4,061,000	9.8
34	Fabricated Metal Products	1,997,000	4.8
35	Machinery, Except Electrical	322,000	0.8
36	Electrical and Electronic Equipment	1,093,000	2.7
37	Transportation Equipment	1,240,000	3.0
38	Instruments and Related Products	90,000	0.2
39	Misc. Manufacturing Industries	318,000	0.8
--	Non-Manufacturing Industries[1]	1,971,000	4.8
TOTAL		41,235,000	99.9[2]

Data compiled by JRB Associates.

[1] SIC 5085-Drum Reconditioners, SIC 07-Agricultural Services, SIC 5161-Chemical Warehouses, SIC 40-Railroad Transportation, SIC 55-Automotive Dealers and Gasoline Service Stations, SIC 72-Personal Services, SIC 73-Business Services, SIC 76-Misc. Repair Services, SIC 80-Health Services, SIC 82-Educational Services.

[2] Does not total 100% due to rounding error.

Source: 38

XI-2 INDUSTRIAL HAZARDOUS WASTE GENERATION BY REGION, 1980

EPA Region	Quantity (wet kkg)	Percent
I	1,104,000	2.7
II	3,113,000	7.5
III	4,354,000	10.6
IV	10,353,000	25.1
V	6,428,000	15.6
VI	10,536,000	25.5
VII	1,201,000	2.9
VIII	318,000	0.8
IX	2,838,000	6.9
X	995,000	2.4
TOTAL	41,240,000[1]	100

[1]Quantity estimated at 41,235,000 wet kkg; the difference is due to rounding. Range reported by source was 27,765,000 wet kkg - 53,864,000 wet kkg.

Source: 38

XI-3 ESTIMATED HAZARDOUS WASTE GENERATION BY WASTE TYPE, 1980

Waste Type[1]	Quantity (wet kkg)	Percent (%)
Sludges	9,428,258	26.5
Solvents	2,344,701	6.6
Alkali/Caustic	1,526,590	4.3
Acid	711,150	2.0
Heavy Ends	328,390	0.9
Bottoms	281,760	0.8
Other	20,919,750	58.9
TOTAL	35,540,599[2]	100

Data compiled by JRB Associates.

[1]Excludes non-manufacturing category (1,965,844 kkg) for which no breakdown is available.

[2]According to the source report for this table, 1980 hazardous waste generation is estimated to be 37,506,443 kkg. This is less than the Booz-Allen and Hamilton value reported in source 27 (41,235,000 kkg); however, it falls within their reported generation range (27,765,000-53,864,000 kkg).

Source: 39

XI-4 HAZARDOUS WASTE COMPOSITION BY SIC CODE, 1980

SIC CODE	Waste Type (%)						
	Solvents	Sludges	Acid	Alkali/Caustic	Heavy Ends	Bottoms	Other
22	0.6	99.4	--	--	--	--	--
24	--	100.0	--	--	--	--	--
25	12.8	--	--	--	--	--	87.2
26	--	100.0	--	--	--	--	--
27	30.0	--	--	--	--	--	70.0
28	2.9	5.0	2.7	6.4	1.5	0.6	81.0
29	--	81.2	--	--	--	7.8	11.0
30	38.0	--	--	--	--	--	62.0
31	--[1]	75.9	--[1]	--[1]	--	--	24.1
32	--	--	--	--	--	--	100.0
33	4.6	54.5	3.2	2.7	--	--	35.0
34	30.0	50.0	--	--	--	--	20.0
35	30.3	50.5	--	--	--	--	19.2
36	16.4	72.6	--	--	--	--	11.0
37	30.0	50.0	--	--	--	--	20.0
38	29.1	50.6	--	--	--	--	20.3
39	30.2	50.0	--	--	--	--	19.8

Non-Manufacturing -- No breakdown available

Data compiled by JRB Associates.

[1]Process wastes include solvents, alkalines, and acids however the total quantity generated was not broken down by type.

[2]"Other" category represents numerous waste type categories (such as dyes, inks, specific chemicals, spills, etc.) that were not broken down for this table as well as the quantity of wastes under a particular industry that were not broken down by waste type.

Source: 39

XI-5 HAZARDOUS WASTE TRANSPORTERS BY REGION, 1980

EPA Region	Number of Transporters
I	627
II	1,062
III	1,086
IV	1,769
V	2,398
VI	1,267
VII	630
VIII	457
IX	1,132
X	348
TOTAL	10,776

Source: 37

XI-6 ESTIMATED ON-SITE AND OFF-SITE DISPOSAL OF HAZARDOUS WASTE, 1980

EPA Region	Disposal (thousand wet kkg)		
	On-Site	Off-Site[1]	Unknown
I	437	299	368
II	1,921	652	540
III	3,280	604	470
IV	8,766	913	674
V	3,561	1,330	1,537
VI	8,983	1,029	524
VII	716	252	233
VIII	151	106	61
IX	1,792	535	511
X	406	348	241
TOTAL	30,013 (72.8%)	6,068 (14.7%)	5,159 (12.5%)

[1]Although the disposal site distribution of 12.5% of the total waste generated is unknown, source estimates that approximately 23% of the hazardous waste generated is disposed off-site.

Source: 38

XI-7 METHODS FOR OFF-SITE DISPOSAL OF INDUSTRIAL HAZARDOUS WASTE, 1980

Disposal Method	Estimated Quantity (wet kkg)	Percent
Landfill	2,699,000	37.5
Chemical, Biological, and Physical Treatment	2,116,000	29.4
Deep Well Injection	788,000	11.0
Land Treatment/ Solar Evaporation	537,000	7.5
Resource Recovery	424,000	5.9
Incineration	398,000	5.5
Landfill for Chemical Treatment Wastes	230,000	3.2
TOTAL	7,192,000	100

Source: 38

XI-8 ESTIMATED OFF-SITE HAZARDOUS WASTE TREATMENT/DISPOSAL BY REGION, 1980

EPA Region	Type of Treatment/Disposal Method (thousand wet kkg)						
	Landfill	Land Treatment/Solar Evaporation	Incineration	Chemical Treatment[1]	Resource Recovery	Deep-Well Injection	Total Quantity
I	6	-	23	81	35	-	145
II	375	-	26	619	135	-	1,155
III	170	-[2]	48	467	51	-	736[2]
IV	226	-	65	157	22	-	470[2]
V	330	117[2]	97	486	170	152	1,235
VI	650	-	98	146	-	635	1,646[2]
VII	62[3]	-	-	36	3	-	101[3]
VIII	-	-	-	-	-	-	-[3]
IX	822	345	40	294	-	-	1,501
X	59	75	-	62	8	-	204
TOTAL	2,699	537	398	2,346	424	788	7,192

Detail may not add to total due to rounding.

[1]These are gross volumes and include 10 percent of which will require further treatment.
[2]Volume data from Region IV is included in Region VI to prevent disclosure of confidential data.
[3]Although some landfills in the region may handle hazardous waste, these facilities are not included in the data for this table.
Source: 38

XI-9 REGIONAL BREAKDOWN OF HAZARDOUS WASTE TREATMENT/DISPOSAL FACILITIES, 1980

EPA Region	Type of Treatment/Disposal Practice (number of facilities)[1]						
	Landfill	Land Treatment/Solar Evaporation	Incineration	Chemical Treatment	Resource Recovery	Deep-Well Injection	Total Number of Facilities
I	1	0	3	3	5	0	8
II	2	0	1	8	8	0	13
III	3	0	1	8	2	0	11
IV	2	1	7	4	2	0	12
V	11	0	6	16	10	1	37
VI	10	3	6	3	0	8	21
VII	3[2]	0	0	1	1	0	4[2]
VIII	-[2]	0	0	0	0	0	-[2]
IX	10	6	1	2	0	0	14
X	2	1	0	2	5	0	7
TOTAL	44	11	25	47	33	9	127

[1]The sum of these numbers is greater than the total number of facilities because more than one treatment/disposal option may be available at a facility.
[2]Some sanitary landfills may currently be handling hazardous waste. As in other Regions, these facilities are not included in the reported data for this table.
Source: 38

XI-10 COST OF OFF-SITE HAZARDOUS WASTE DISPOSAL, 1980

Disposal Method	Cost[1] ($/wet kkg)
Landfill	
Wastes not acutely hazardous, including sludges	20-90
Highly toxic, explosive, or reactive wastes	100-400
Land Treatment	5-25
Incineration	
High BTU value, no acute hazard	50-300
Highly toxic, heavy metals	300-1000
Chemical Treatment	
Acids, alkalines	15-80
Cyanides, heavy metals, highly toxics	100-500
Resource Recovery	50-200
Deep-Well Injection	
Oily wastewaters	15-40
Dilute toxic rinse waters	50-100

[1] Actual reported prices for treatment and disposal of hazardous waste, excluding transportation.

Source: 38

XII. Miscellaneous Information

XII-1 COMPARISON OF ENERGY VALUES OF MUNICIPAL SOLID WASTE AND CONVENTIONAL FUELS

Energy Source	Energy Values (Btu/lb)
Municipal Solid Waste (MSW)	4500
Refuse Derived Fuel (RDF) - Fluff	5000-6000[1]
Refuse Derived Fuel (RDF) - Dust	7800[1]
Peat	3235
Wood	4690
Lignite	7065
Sub-bituminous B	10245
Anthracite	11100
Bituminous - Hi Volatile B	12235
Bituminous - Volatile	14460
#6 Fuel Oil	18265
#2 Home Heating Oil	19565
Methane	23895

[1]Value from USEPA Resource Recovery Seminar, Chicago, IL, June 1977.

Source: 43

XII-2 COMMON ENERGY EQUIVALENTS

One Ton of MSW	= 9 million Btu
One Barrel of Crude Oil (42 gals)	= 5.8 million Btu
1000 Cubic Feet of Natural Gas	= 1.0 million Btu
One Gallon of Gasoline	= 0.1276 million Btu
One Gallon of Diesel Fuel	= 0.1303 million Btu
One Kwh	= 0.003414 million Btu

Source: 23

XII-3 DENSITIES OF REFUSE AND ASSOCIATED MATERIALS

Material	Density (lb/cu yd)
Loose refuse, no processing	100-200
Refuse from a compactor truck, after dumping	350-400
Refuse in compactor truck	500-700
Shredded refuse	600-900
Refuse baled in paper baler	800-1200
Refuse in landfill	500-900
Dry ash residue	1080
Wet ash residue	1350
Processed Materials	
Ferrous cans (flattened)	800-900
Aluminum cans (flattened)	250
Mixed glass, minus 5/8" cullet	2300
Mixed glass, minus 2" cullet	1000
Baled shredded paper bundles	750

Sources: 15, 40, 44

XII-4 DENSITIES OF PURE REFUSE COMPONENTS

Component	Specific Gravity	Density (lb/cu ft)
Aluminum	2.70	168
Cardboard	0.69	43
Glass	2.50	156
Paper	0.7-1.15	44-72
Steel	7.70	480
Wood	0.60	37
Plastics		
Acrylic	1.18	74
ABS	1.03	64
Polyethylene	0.94	59
Polypropylene	0.90	56
Polystyrene	1.05	65
PVC	1.25	78

Source: 7

XII-5 TYPICAL CHEMICAL COMPOSITION OF MUNICIPAL REFUSE COMPONENTS (ULTIMATE ANALYSIS)

Refuse Component	C(%)	H_2(%)	O_2(%)	N_2(%)	S(%)	Inerts[1]	Percent Moisture
Newspapers	49.14	6.10	43.03	0.05	0.16	1.43	5.97
Brown paper	44.90	6.08	47.84	0	0.11	1.01	5.83
Magazine paper	32.91	4.95	38.55	0.07	0.09	22.47	4.11
Corrugated boxes	43.73	5.70	44.93	0.09	0.21	5.06	5.20
Plastic coated paper	45.30	6.17	45.50	0.18	0.08	2.64	4.71
Waxed milk cartons	59.18	9.25	30.13	0.12	0.10	1.17	3.45
Paper food cartons	44.74	6.10	41.92	0.15	0.16	6.50	6.11
Junk mail	37.87	5.41	42.74	0.17	0.09	13.09	4.56
Tissue paper	43.9	6.1	49.0			0.93	7.00
Cardboard	45.52	6.08	44.53	0.16	0.14	3.57	
Miscellaneous paper	44.00	6.15	41.65	0.43	0.12	7.65	
Vegetable and food wastes	49.06	6.62	37.55	1.68	0.20	1.06	78.29
Citrus rinds, seeds	47.96	5.68	41.67	1.11	0.12	0.74	78.70
Meat scraps, cooked	59.59	9.47	24.65	1.02	0.19	3.11	38.74
Fried fats	73.14	11.54	14.82	0.43	0.07		
Garbage	41.72	5.75	27.62	2.79	0.25	21.87	
Leather	42.01	5.32	22.83	5.98	1.00	21.16	7.46
Rubber Composition, heel, sole catch	53.22	7.09	7.76	0.50	1.34	29.74	1.15
Plastics							
Average	78.0	9.0	13.0				
High	90.0	10.0					
Low	55.8	7.0	37.2				
Polyethylene	85.6	14.4					
Vinyl	47.1	5.9	18.6(chlorine=28.4%)				
Plastic film	67.21	9.72	15.82	0.46	0.07	6.72	
Mixed, from municipal refuse, contaminated with food waste							
Other plastics, rubber, leather	47.70	6.04	24.06	1.93	0.55	19.72	
Paints, oils	52.1	13.1	34.8				
Vacuum cleaner	35.69	4.73	20.38	6.26	1.15	30.34	5.47
Evergreen trimmings	48.51	6.54	40.44	1.71	0.19	0.81	69.00
Flower, garden plants	46.65	6.61	40.18	1.21	0.26	2.34	53.94
Lawn grass, green	46.18	5.96	36.43	4.46	0.42	1.62	75.24
Ripe tree leaves	52.15	6.11	30.34	6.99	0.16	3.82	9.97
Softwood, pine	52.55	6.08	40.90	0.25	0.10	0.12	
Hardwood, oak	49.49	6.62	43.39	0.25	0.10	0.15	
Wood	49.00	6.0	42.00			2.28	24.00
Grass and dirt	36.20	4.75	26.61	2.10	0.26	30.08	
Rags	43.9	6.1	49.0			0.93	7.00
Textiles	46.19	6.41	41.85	2.18	0.20	3.17	
Dirt						100.00	
Glass bottles	0.52	0.07	0.36	0.03		99.02	
Glass, ash, ceramics						100.00	
Glass, stones, ceramics	(same as above, glass bottles)						
Metal cans	4.54	0.63	4.28	0.05	0.01	90.49	
Metals						100.00	

[1] Inerts - ash, glass, metal, stone, ceramics

Source: 7

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